CONFIDENTIAL

MATERIAL AND FLIGHT TEST

BALLOON TYPE 302-P #3

CONTRACT NONR 2484(00)

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MATERIAL AND FLIGHT TEST

ON

BALLOON TYPE 302-P

00111

PERSONNEL CARRIER

PROJECT 209

UNDER

CONTRACT NONR 2484(00)

Prepared by:

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INTRODUCTION

Under Project 209, Contract NONR 2484(00), Raven Industries, Inc. undertook the materials testing and flight test of balloon type 302-P, Personnel Carrier, Stock No. 0530-Hoo-1465X, manufactured by General Mills, Inc., from the sponsor's storage supply.

The purpose of these tests was to find whether the balloon, as representative of a type in storage of similar design and date of manufacture, could be utilized in actual flight.

It was found that the balloon could carry personnel if certain pre-flight conditions are observed.

The nature and results of these tests are set down within.

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PART I.

PRELIMINARY INSPECTION

OF

BALLOON TYPE 302-P

MANUFACTURED BY

GENERAL MILLS, INC.

25 January 1960

PREPARED AS PART

OF

PROJECT 209

UNDER

CONTRACT NONR 2484(00)

Submitted by:

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Under Contract Nonr 2484(00), Project 209, a careful pre-flight examination was made on balloon Model 302-P (Stock No. 0530-1400-1465X).

The balloon was removed from the shipping container; however, it was left in the clear plastic liner.

Under close visual inspection, it was found that the adhesive from the pressure sensitive tapes had bled on one side of the protective liner. That is, the tape adhesive had melted and run between the layers of the balloon. Since the area of bleeding was restricted to one region, it was theorized that previous storage or handling had caused one side of the shipping container to be placed near a heat source. The Minnesota Mining #890 glass filament reinforced tape used in Model 302-P would melt and run at approximately 150 degrees F.

The folded balloon was stuck together. Extreme care was taken to remove the sticky folds of the packed balloon without tearing the polyethylene envelope. (See Post Flight Tests on Seals, etc. for thickness and material.)

The area around the manual release valve was inspected and it was found that the original cornstarch had become mouldy. Further inspection revealed no damage to the tapes or the polyethylene envelope.

The duct, inflation tube and harness were in good order.

Since the adhesive had run from the tapes, the balloon, folded in layers for shipment, was stuck together wherever the outer surfaces of the gore tapes touched the balloon envelope. These layers were carefully detached and the adhesive neutralized by an application of cornstarch to preven t the balloon from adhering when re-folded.

During the process of neutralizing the adhesive, each gore tape was thoroughly inspected. In some spots, the tapes were found pulled away from the polyethylene. Visual evidence supported the theory that the polyethylene skin had been stretched slightly when the tapes were adhered. When the polyethylene film had relaxed to its original form the tapes were forced up in several spots. There was an average of three of these buckled areas on each gore.

In these same areas, delamination between the filament tape and its cellophane coating had taken place; the coating breaking in many instances.

However, the polyethylene envelope was found devoid of any abrasions, tears, slits, etc.

The manual release valve was disassembled and closely inspected. This was found in satisfactory condition and reassembled.

A new reefing sleeve and wrapper was made for the balloon and 302-P was covered with a protective liner and repacked.

It is felt that this model balloon can be made suitable for flight. However, extremely close inspection by competent inspectors is required in the unpacking, handling, and readying of this vintage balloon for actual flight. While the process of cornstarching is a necessity, continued visual inspection is deemed a requisite to check and remedy damage from previous handling of this type of balloon.

Figure 1.
Bled Adhesive Between The Layers Of

PART II.

RAVEN FLIGHT TEST ON BALLOON 302-P

FLIGHT NO. 649

27 April 1960

PREPARED AS PART OF PROJECT 209

UNDER

CONTRACT NONR 2484(00)

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After visually inspecting and cornstarch lubricating the 302-P personnel carrying balloon, it was decided to flight test the unit prior to its disassembly for material testing.

The balloon was inflated (with gondola and load attached) to 924 pounds of lift. At this time, it was in a balanced or "weighed off" condition. The gondola was raised a few feet above the concrete ramp inflation area and manually forced downward against the ramp with considerable force. This action caused a reverberation throughout the balloon and created abnormal strains throughout the system. If any weak points existed in the balloon envelope it would have ruptured during this test. The "bouncing" test was continued two more times and then was considered satisfactory for flight.

At 0640 CST, the flight was airborne and a rate of rise of 250 feet per minute was maintained until reaching the floating altitude of 4500 feet m.s.l. (3000 feet above the terrain).

This floating altitude remained constant without ballast which indicates that no holes existed in the balloon envelope.

After floating at the 4500 foot level for 1-1/2 hours, a portion of the sand ballast was jettisoned to allow an altitude of 7000 feet to be reached.

FLIGHT NO. 649

	Lbs.
Balloon	62.5
Gondola	51.0
2 Parachutes	53.0
Skycrafter Transceiver	15.0
Small Beacon	6.0
Pilot Weight: Mr. Yost	180.0
Mr. Keuser	184.0
Extra clothing worn by both men	34.0
Banners and Seat Cushions	12.0
TOTAL	597.5
Sand (or Ballast)	327.0
TOTAL GROSS LOAD	924.5

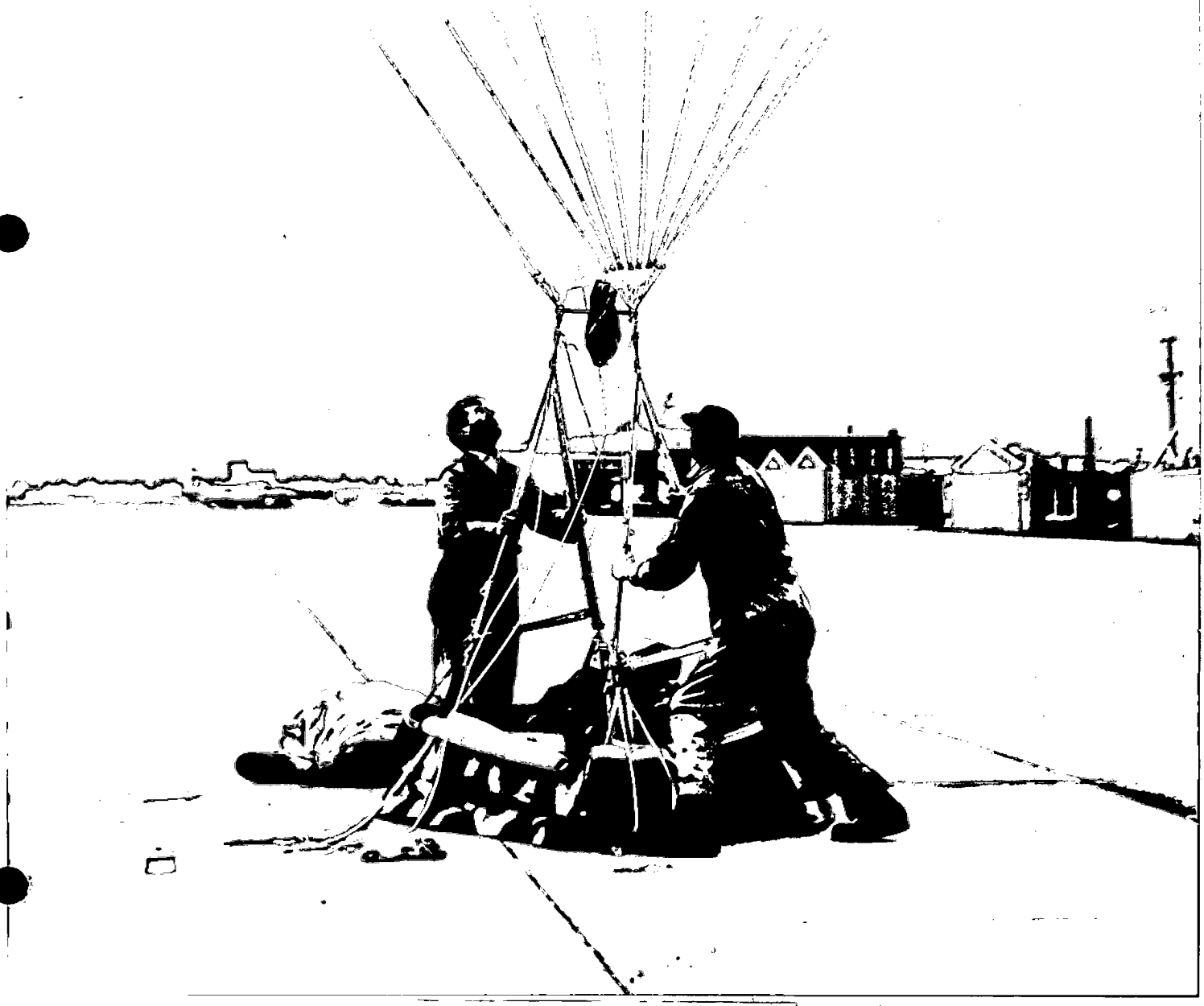

Figure 2.
Pre-Flight Bounce Test

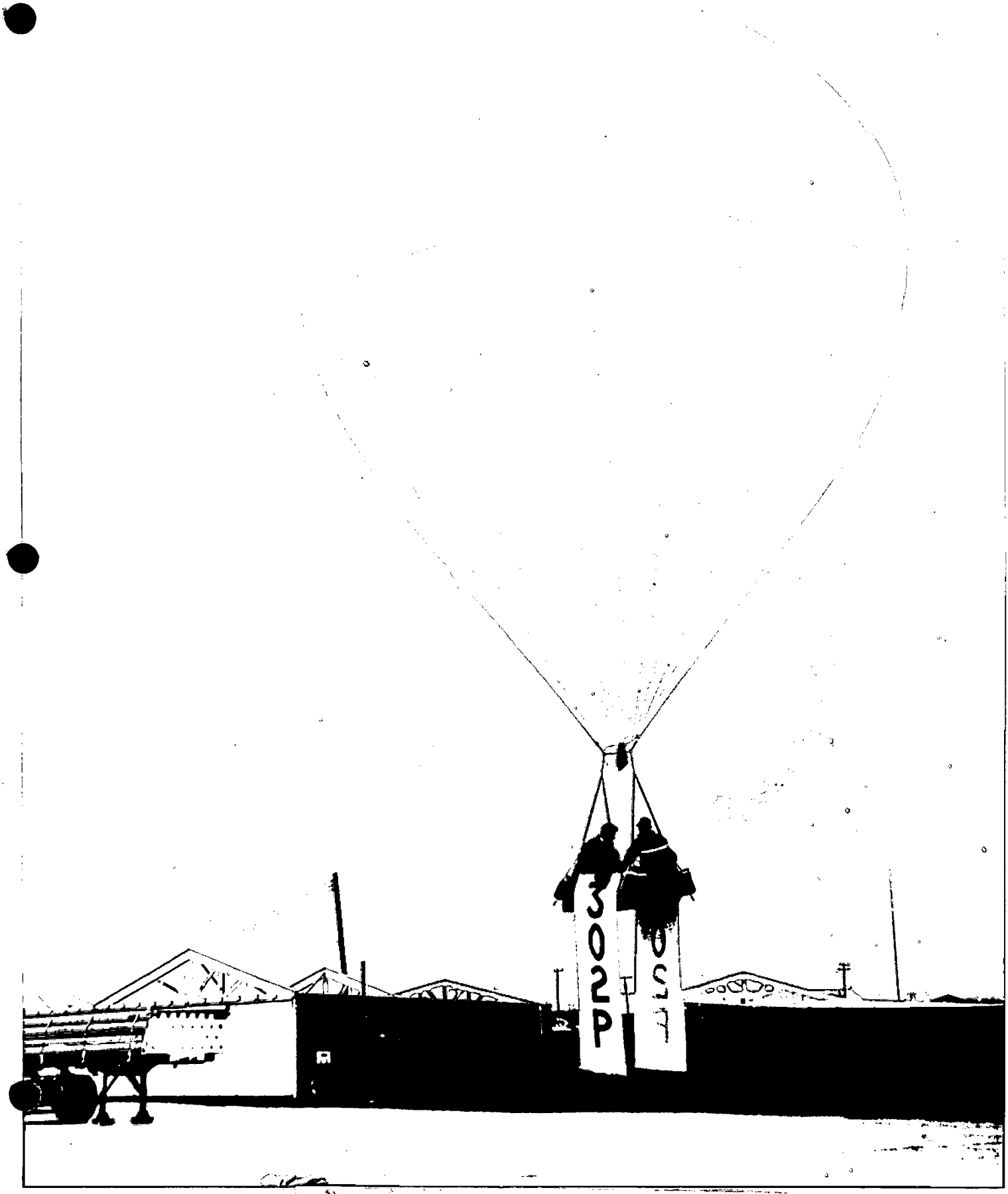

Figure 3.
Balloon 302-P Shortly After Launch

PART III.

POST STORAGE, POST FLIGHT TEST OF SEALS AND LOAD TAPES OF BALLOON TYPE 302-P MANUFACTURED BY GENERAL MILLS, INC. AND FLOWN BY RAVEN INDUSTRIES, INC. 27 APRIL 1960

PREPARED AS PART

OF

PROJECT 209

UNDER

CONTRACT NONR 2484(00)

Submitted by:

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John P. Donaghue
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Approved by:

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Under Contract Nonr 2484(00), Project 209, post-flight tests were made on seals, film, and load tapes of balloon Model 302-P, manufactured by General Mills, Incorporated, date of manufacture unknown.

Seals were tested for tensile strength in the transverse direction of the film. The film was tested for tensile strength in the transverse direction, and for thickness of the film. The load tapes, 1 inch #890 (Minnesota Mining and Manufacturing Company, St. Paul, Minnesota), were tested for adhesion to the film. The test for adhesion was in compliance with ASTM standard D903 with the following exceptions: The sample tested was three inches long, the backing strip was also #890 tape, the rate of separation of the jaws was 4 inches per minute.

All tensile and adhesion tests were made on a pendulum type tester. Thwing Albert Model 35-4EL-24, Serial No. 18505. Thickness was measured with a micrometer reading to the tenth of a mil. Both tensile tester and micrometer were checked before and after testing.

THICKNESS:

Three gores chosen at random were tested in four different places, with the following results.

Gore #1	Gore #2	Gore #3
.0025	.0030	.0030
.0029	.0031	.0029
.0028	.0027	.0027
.0030	.0026	.0032
4/.0112	4/.0114	4/.0118
.0028 Avg.	.0028 Avg.	.0029 Avg.

TENSILE STRENGTHS:

The following figures are based on a nominal thickness of 3 mils.

Sample widths of one inch were taken from each gore.

Test #	Seal lbs.	Mat'l lbs./in^2	Parent lbs.	Mat'l lbs./in^2	%
1	4.75	1580	8.80	2940	54
2	4.95	1650	8.50	2830	58
3	6.35	2110	9.20	3070	69
4	6.65	2215	9.35	3120	71
5	6.20	2065	8.60	2870	72
6	4.90	1635	9.50	3170	52
7	6.90	2300	9.20	3070	75
8	6.20	2065	8.40	2800	74
9	5.75	1920	8.60	2870	67
10	6.10	2030	9.65	3220	63
11	No Test				
	5.95	1980	8.60	2870	69
12	6.55	2180	8.55	2850	77

LOAD TAPE ADHESION:

Test No.	Time For Separation Minutes	Reading in Lbs. Max.	Min.	Effect on Film
1	1.85	0.74	0.63	None
2	1.62	.82	.68	"
3	1.62	1.07	.85	"
4	1.64	.83	.62	"
5	1.61	.89	.67	"
6	1.69	.79	.56	"
7	1.59	.89	.57	"
8	1.57	.77	.53	"
9	1.56	.76	.59	"
10	1.57	.86	.63	"
11	1.69	.85	.60	"
12	1.64	.77	.63	"
13	1.64	.70	.45	"
14	1.65	.78	.61	"
15	1.68	.75	.43	"
16	1.56	.74	.63	"
17	1.64	.99	.88	"
18	1.60	.83	.55	"
19	1.70	.79	.60	"
20	1.67	.97	.65	"
21	1.58	.84	.60	None

22	1.68	.82	.65	"
23	1.57	.86	.67	"
24	1.63	.98	.68	"

The attached stress-strain graphs are the results of the tensile tests of seals and parent materials. Graphs 1, 2, 3, and 4 are of tests 1-3, 4-6, 7-9, and 10-13 respectively. Test #11 was declared "no test" and re-done.

CONCLUSION

From the preliminary inspection, flight test and post flight tests on materials, it was felt that balloon 302-P as representative of a type is fully capable of being utilized for actual flights. However, it must be stressed that only under close inspection can these balloons be allowed in the air. Re-application of cornstarch by trained personnel and a competent inspector is mandatory for the success of these operations.

A pre-flight shock test on the flight line (mentioned in Part II.) is an added safeguard before each flight.

Great care must be exercised in unpacking and handling these balloons. Only under close supervision and continual inspection can these prototypes be made secure.

James A. Winker

James A. Winker - Senior Engineer

Dated: 24 May 1960

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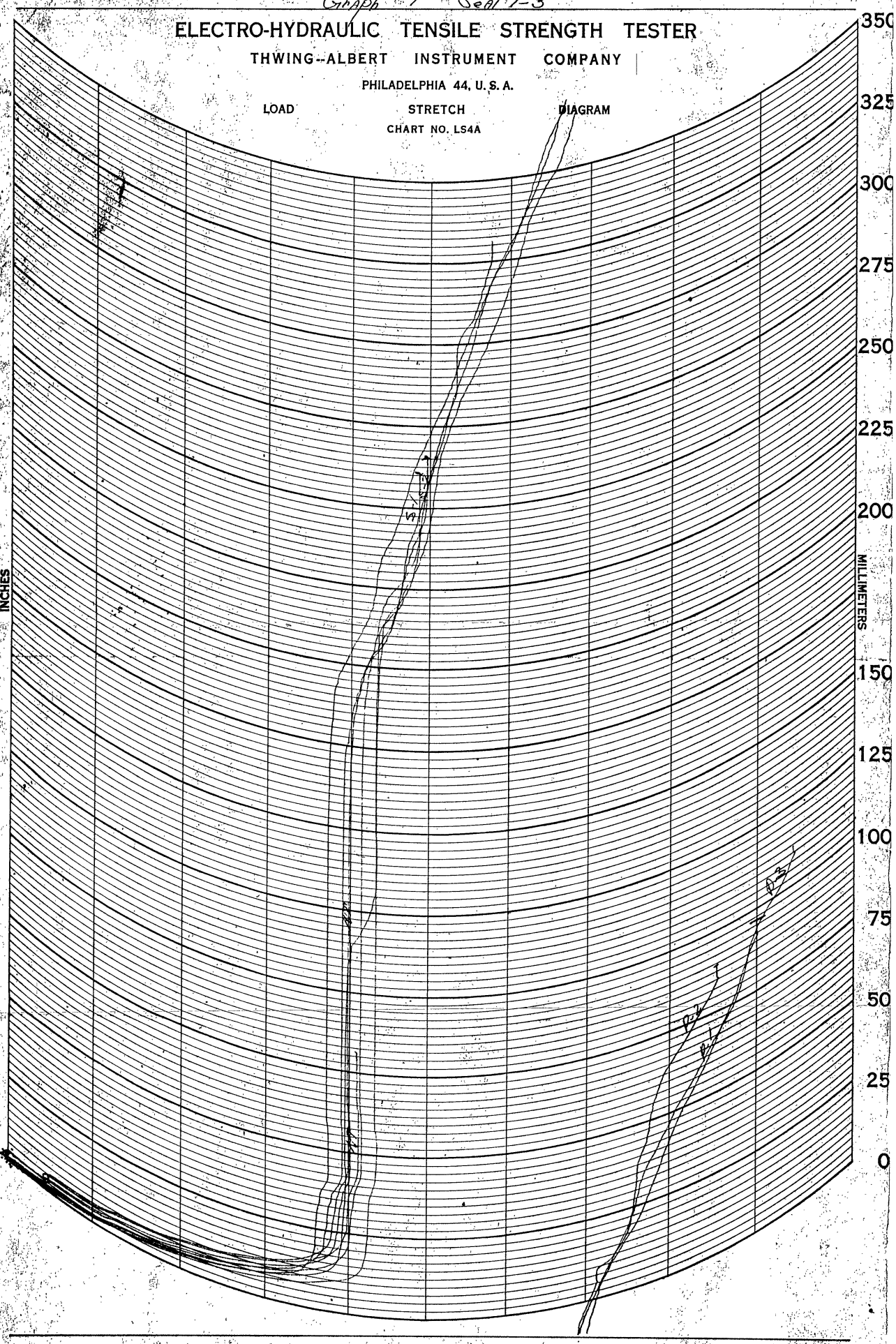
Graph #1 Seal 1-3



Graph #2 4-6

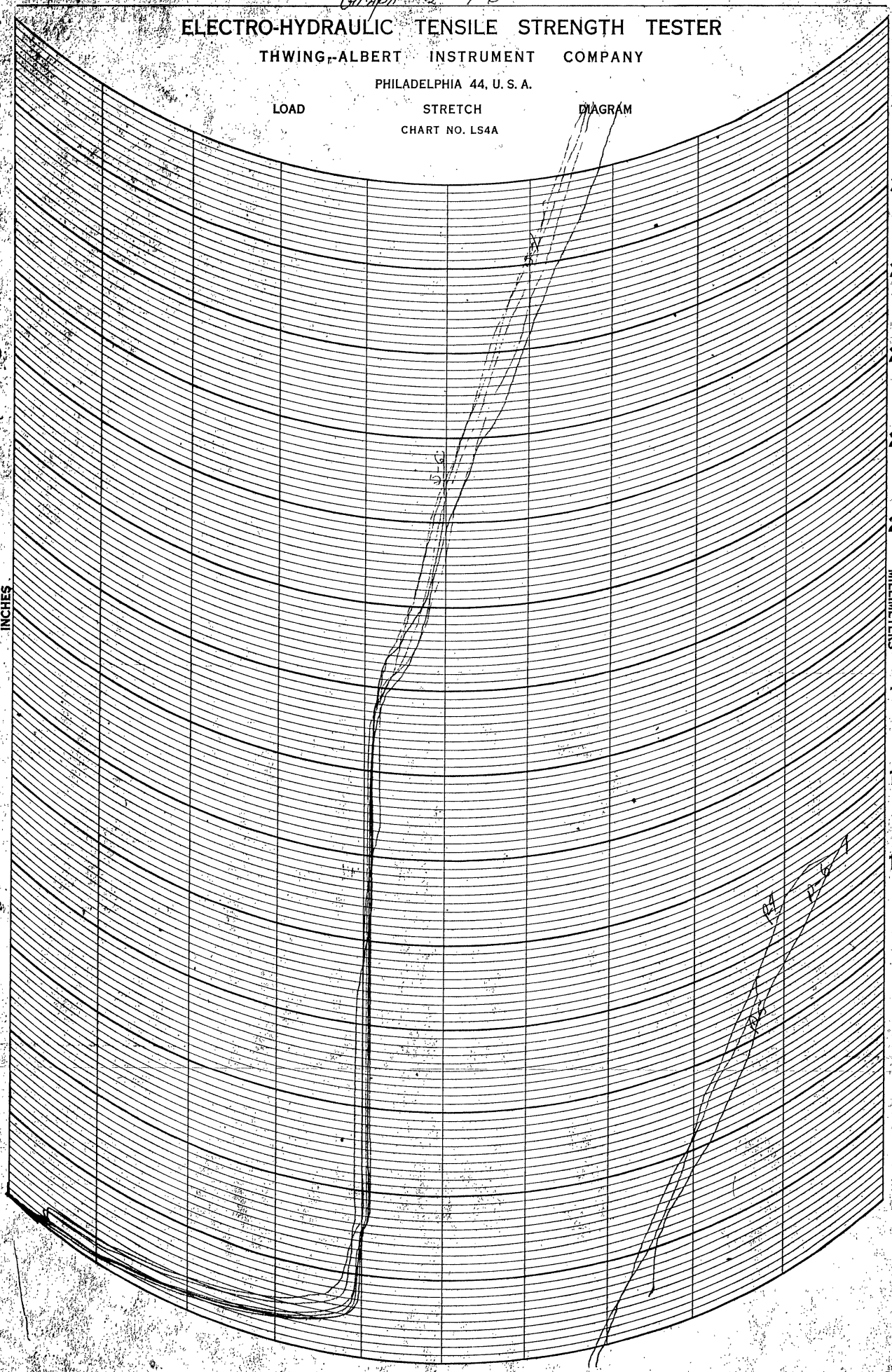
ELECTRO-HYDRAULIC TENSILE STRENGTH TESTER

THWING-ALBERT INSTRUMENT COMPANY

PHILADELPHIA 44, U. S. A.

LOAD STRETCH DIAGRAM

CHART NO. LS4A



Graph #1 Seal 1-3